PATENT APPLICATION
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METHOD AND APPARATUS FOR SUPPORTING MULTIPLE DISPLAYS

Technical Field of the Invention

This invention relates generally to video graphics and more particularly to supporting multiple displays from a single drawing surface.

Background of the Invention

Computers are known to comprise of a central processing unit, system memory, audio processing circuitry, peripheral ports, and video processing circuitry. The peripheral ports allow the central processing unit to communicate with peripheral devices such as monitors, printers, external tape drives, the internet, etc. Video graphics circuitry functions as a co-processor to the central processing unit to perform video graphic functions. As such, the video graphics processor receives graphical data generated by the central processing unit and renders the graphical data into pixel data that is subsequently displayed on a monitor.

Video graphic circuitry may be coupled to a single display or to multiple displays. When coupled to a single display, a frame buffer holds the pixel data that is subsequently provided to the display. Typically, the pixel data is mapped into the frame buffer based on physical parameters of the monitor (e.g., resolution and X, Y coordinates). The mapping of the frame buffer may be linear mapping or tile mapping. Regardless of the mapping technique, the display presents, in a full screen, the image or images stored in the frame buffer.

When the video graphics processing circuit is supplying pixel data to multiple displays, a primary display provides display parameters to the operating system. This arises because the operating system includes a single display parameter register for each video graphics controller of the computing system. As such, the operating system is not designed to support a video graphics controller driving two or more displays. When the graphics controller is driving two or more displays, all of the displays are limited to the display parameters of the primary display. As such, displays having capabilities that exceed the primary display may be disabled, or at best, limited. In addition, such an operating system does not support a virtual desktop operation.

As is known, the virtual desktop mode enables a lower resolution display to display larger resolution drawing surfaces. As such, when in the virtual desktop mode, only a portion of the image in the frame buffer is presented on screen. To view other portions of the image, a mouse, or other GUI action is performed. However, to support multiple displays, and/or the virtual desktop mode, requires modification of the operating system interface, does not allow upgrading of the operating system without reconfiguring the interface, and is complex. Obviously, such intrusions on the operating system are less than desirable and limit commercial viability.

As is also known, a computing system may include a plurality of video graphics cards, or controllers, each having a separate display register associated with the operating system. If each card, or controller, is supporting a single display, all of the displays operation in full screen mode without limitations. Each card or controller, however, may support multiple displays, giving rise to the above mentioned problems.

Therefore, a need exists for a method and apparatus that supports multiple displays operably coupled to a single drawing surface to support virtual desktop mode without the complexity or interface changes needed in current implementations and without limiting displays having greater capabilities.

Brief Description of the Drawing

Figure 1 illustrates a schematic block diagram of a computing system in accordance with the present invention;

Figure 2 illustrates a schematic block diagram of a multiple display support module in accordance with the present invention; and

Figure 3 illustrates a logic diagram of method for supporting multiple displays per drawing surface in accordance with the present invention.

Detailed Description of a Preferred Embodiment

Generally, the present invention provides a method and apparatus for supporting multiple displays per a drawing surface. Such processing begins by receiving capability parameters regarding a first display of the multiple displays. The capability parameters include resolution, pixel depth, and/or refresh rate. Typically, the first display will be the primary display associated with a video graphics card. The processing continues by substituting selected display capabilities for the capability parameters of the first display. The selected display parameters are such that it exceeds the display capability parameters of each display, or monitor, coupled to the video graphics card. The processing continues by providing the selected display capabilities to an operating system. The operating system then stores the selected display capabilities in the display register associated with a particular video graphics card. With such a method and apparatus, substituting the display parameters of a single display with all encompassing display parameters, allows a multitude of displays to be coupled to a single drawing surface without limiting displays having greater display capabilities and overcoming the intrusions into the operating system.

The present invention can be more fully described with reference to Figures 1 through 3. Figure 1 illustrates a schematic block diagram of a computing system 10. Such a computing system 10 may be a personal computer, laptop computer, video game, personal digital assistant, palm top computer, hand-held computer and/or any device that performs programs and or algorithms. The computing system 10 includes a central processing unit 12, system memory 14, a first video graphics card 16, a second video graphics card 18, and a plurality of displays 20-26. The central processing unit 12 includes a first video graphics register 28 and a second video graphics register 30. Each of these registers is operably associated with one of the video graphics cards and stores display capability parameters of the primary display associated with the video graphics card. Note that in accordance with the present invention the display capability parameters of a primary display will be overwritten within these registers by the selected display capabilities.

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The system memory 14 stores an operating system algorithm 32. As is known, the operating system 32 functions to start up the computing system 10 and to maintain operation. As part of the start-up procedure, the operating system provides inquiries to the video graphics cards 16 and 18 to obtain the display capability parameters of a primary display associated therewith. In accordance with the present invention, the video graphics card 16 and 18 will provide, during some portion of execution of the operating system start-up, the selected display capabilities. The providing of the selected display capabilities will be discussed in greater detail with reference to Figure 2 and 3.

The video graphics card 16 is a representative schematic block diagram of the video graphics cards that may be incorporated in the computing system 10. Video graphics card 16 includes a drawing engine 34, a graphics driver 36, a drawing surface 38, a first controller 40, and a second controller 42. As shown, controller 40 is operably coupled to display 26 and controller 42 is operably coupled to displays 22 and 24. As such, the video graphics card 16 supports three displays. Each of the displays may be driven from the drawing surface 38 such that they each display the same images.

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In operation, the drawing engine 34 receives graphical data from the central processing unit and/or video inputs from a video decoder and processes them into RGB data. The graphics driver 36 receives the RGB data and coordinates the storage within the drawing surface 38. In addition, the graphics driver 36 coordinates the retrieval of the RGB data from the drawing surface 38 and provides it to controllers 40 and/or 42. Note that the central processing unit may provide the same or different graphics data to the video graphics cards 16 and 18. As one of average skill in the art would readily appreciate, the computing system 10 may include a single video graphics card that supports multiple displays and/or multiple video graphics cards that each support a single or multiple displays.

Figure 2 illustrates a schematic block diagram of a multiple display support module 50 that includes a processing module 52 and memory 54. The multiple display support module 50 may be incorporated in the central processing unit and/or on the video graphics card. The processing module 52 may be a single processing entity or a plurality of processing entities. Such a processing entity may be a microprocessor, microcontroller, microcomputer, digital signal processor, a portion of the central processing unit, digital signal processor, state machine, logic circuitry and/or any device that manipulates digital information based on operational instructions. The memory 54 may be a single memory device or a plurality of memory devices. Such a memory device may be a read-only memory, random access memory, floppy disk memory, a portion of the system memory, CD memory, DVD memory, magnetic tape memory and/or any device that stores digital information. Note that if the processing module includes a state machine and/or logic circuitry to perform one or more of its functions, the memory that stores the corresponding operational instructions is embedded within the circuitry that comprises the state machine and/or logic circuitry.

The memory 54 stores operational instructions that, when executed by the processing module causes the processing module 52 to support multiple displays per a

drawing surface. Such operational instructions may be further described with reference to Figure 3.

Figure 3 illustrates a logic diagram of a method for supporting multiple displays per drawing surface. The process begins at step 60 where capability parameters regarding a first display are received. The receiving of the capability parameters, which include resolution, pixel depth, and/or refresh rate, may be received in accordance with a system start-up controlled by the operating system or in response to a monitor change process. Such a monitor change process may be, for example, switching from an LCD display only to an LCD and CRT display mode.

The processing continues at step 62 where selected display capabilities are substituted for the capability parameters. The selected display capabilities include display parameters that exceed the display capabilities of each of the multiple displays coupled to the computing system 10. For example, if the computing system 10 has three displays coupled to a single video graphics card, where the first display has a pixel resolution of 640 x 480, the second 720 x 540 and the third 1024 x 768, the selected display capabilities would have a resolution at least as great as 1024 x 768 and may further be increased to 1920 x 1440 or higher. As such, the selected display capabilities may be determined based on a composite of the display parameters of each of the multiple displays, such an as average, a maximum display parameters, or default maximum display parameters. Alternatively, the selected display parameters may be determined based on capabilities of the video graphics card, for example, the video graphics card may be capable of handling a certain size display.

The process then proceeds to step 64 where the selected display capabilities are provided to the operating system. The operating system, upon receiving the selected display capabilities, causes them to be stored in a video graphics register associated with a particular video graphics card.

Step 66 through 70 illustrate one possible implementation of the substitution as performed at step 62. At step 66, the capability parameters of the first display are identified as primary parameters in accordance with a first portion of the system start-up. As such, during the start-up and prior to boot up of the video graphics card, or boot up of a computing system, the operating system requests that each video graphics card provide its primary display parameters to the associated registers. The process then proceeds to step 68 where the capability parameters are provided to the operating system in accordance with the first portion of the system start-up. As such, the primary parameters are provided to the operating system and stored in the corresponding register of the operating system. The process then proceeds to step 70 where the selected display capabilities are identified based on the primary parameters in accordance with a second portion of the system start-up. The second portion of the system start-up corresponds to when the video graphics controller is being booted up such that it may provide the selected display capabilities to the associated register of the operating system thereby overriding the primary parameters with the selected display capabilities.

The preceding discussion has presented a method and apparatus for supporting multiple displays per drawing surface. By utilizing selected display capabilities, which exceeds the display parameters of the displays coupled to the video graphics card, the CPU generates the graphics data based on the selected parameters. As such, the video graphics card, or controller, can process the graphics data such that each of the displays operates in full screen mode or in a virtual desktop mode. In addition, the operating system interface does not have to be modified to enable the virtual desktop mode and is done with much less complexity. As one of average skill in the art would appreciate, other embodiments of the present invention may be derived from the preceding discussion without deviating from the spirit of the present invention.